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Signed Andrew Gray

Dated 13 OCT 2000

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference

PA 3468

2. Patent application number
(The Patent Office will fill in this part)

9923266.2

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Textron Fastening Systems Limited
Mundells
Welwyn Garden City
Herts
AL7 1EZ
England

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

UK7499296001

Gustav Klauke GmbH
Postfach 100552
D-42805
Remscheid
GERMANY

7752728001

GERMANY.

4. Title of the invention

RIVETING APPARATUS

5. Name of your agent *(if you have one)*

SOMMERVILLE & RUSHTON

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

45 Grosvenor Road
St Albans
Herts
AL1 3AW

Patents ADP number *(if you know it)*

1511001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

RIVETING APPARATUS

The present invention relates to riveting apparatus, and more particularly to hand-held riveting apparatus of the type in which is driven by a battery-powered electric motor.

One such form of apparatus is described in US 5 473 805. This is a tool for riveting by means of blind breakstem rivets of the well-known type in which the rivet is placed by pulling a breakable stem with respect to a tubular body. The pulling head includes a reciprocable element, which is permanently connected to the electric motor by means of a mechanical gearbox, the electric motor being reversible in order to reverse the movement of the reciprocable element. Riveting tools according to US 5 473 805 have found acceptance in industry, but however they have the disadvantage of being relatively inefficient.

The present invention aims to allow the design and construction of riveting apparatus which is more efficient.

The invention provides, in one of its aspects, a hand-held riveting tool as defined in claim 1 of the appended claims. Further features of the invention are defined in the various sub-claims.

A specific embodiment of the invention will be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a section through a hand-held battery-powered breakstem blind riveting tool;

Figure 2 is an enlargement of part of Figure 1;

Figure 3 is a view on the line III of Figure 1;

Figures 4A, 4B and 4C show progressive positions of the reservoir inlet valve;

actuation of a trigger 31 which is pivoted at 32 to the body of the tool, and carries a pair of projections 33 which contact the valve 29 in order to actuate it.

Mounted adjacent the trigger-operated valve 29 is an electrical switch 34 (Figure 4), which is connected by means of electrical wiring (not shown) to actuate a relay 35 to connect a battery 36, housed at the bottom end of the pistol grip 18, to actuate the motor 26 to drive the pump 22.

The arrangement of the trigger 31, valve 29 and switch 34 is such that, when the trigger 31 is progressively depressed by progressively increasing force from the finger of an operator grasping the pistol grip 18, firstly the valve 29 is closed, thereby preventing flow of hydraulic fluid into the reservoir 23, and thereafter the switch 34 is closed, thereby starting the electric motor 26 and the pump 22. When the trigger 31 is released, firstly the switch 34 opens to shut off the electric motor 26 and pump 22, and thereafter the valve 29 is opened. Moreover, it is arranged that during the time when the valve 29 is closed as just described, nonetheless it can still operate as a pressure relief valve to relieve into the reservoir any dangerously high pressure of hydraulic fluid which may build up. As previously mentioned, the switch 34 is mounted adjacent the valve 29, so that the actuating button 37 of the switch (see Figure 4) is actuated by a moving part of the valve 29 which is moved by operation of the trigger 31.

Figure 4 shows the construction and operation of the valve 29. It comprises a generally cylindrical tubular body 38 in which can reciprocate a generally cylindrical valve member 39. In the top end wall 41 of the valve body 38 is a circular inlet port 42, which can be closed by means of a conical projection 43 at the top of the valve member 39. When the inlet port 42 is open it communicates with a lateral outlet 44 to allow hydraulic fluid into the reservoir 23. Around the lower part of the valve

spring 48 to progressively push the valve member upwards, towards its closed position. Figure 4B illustrates the valve member 39 in its fully closed position, with the conical projection 43 sealing the inlet part 42 under the urging of the first spring 47. The switch 34 is still not actuated, i.e. it is still in its "off" position.

As the operator applies still more force to the trigger 31, the projections 33 apply more force to the bottom of the sleeve 45, and lifts the sleeve 45 out of contact with the washer 46, whilst compressing the second spring 49 even further. When the sleeve 45 has left contact with the washer 46, the second spring 49 no longer has any effect in reducing the closing force exerted by the first spring 48 on the valve member 39. Hence the closing force on the valve is a predetermined known value, so that the valve will operate as a pressure relief valve at a predetermined over-pressure of the hydraulic fluid. This will allow hydraulic fluid to be safely returned to the reservoir 23, regardless of sustained operation of the tool –actuating device, i.e. if the operator keeps the trigger 31 depressed for a long time so that the head piston 14 contacts the cylinder cap.

As the sleeve 49 continues to rise in this way, its projecting lug 52 actuates the button 37 of the switch 34. This starts the electric motor 26, which operates the pump 22. This applies hydraulic fluid under pressure to the space 16 on the pulling head 11, thus actuating the head mechanism to place a rivet, the drawbar 13 being retracted against the urging of spring 17. When the rivet has been placed, the operator releases the force on the trigger 31. The sequence of movements described above is reversed. Firstly the sleeve 45 descends, allowing the switch 34 to turn off and stop the pump 28. Then the valve member 39 is allowed to move away from the inlet part 42, thus allowing hydraulic fluid to be ejected from the head cylinder space 16 by piston 14 under the urging of spring 17, and into the reservoir 23. The piston 14, drawbar 13

CLAIMS

1. A hand-held riveting tool driven by a battery-powered electric motor, comprising a hydraulically-actuated riveting head, and a hydraulic pump driven by the electric motor, whereby when the motor is operated it drives the hydraulic pump to actuate the riveting head.

2. A riveting tool as claimed in claim 1, including a tool-actuating device such as a trigger, and also including a reservoir for hydraulic fluid, the hydraulic supply line from the pump to the riveting head being connected to the reservoir by a reservoir inlet valve which is normally open to allow hydraulic fluid to flow from the supply line into the reservoir, in which operation of the tool-actuating device firstly closes the reservoir inlet valve, and then switches on the electric motor to operate the pump.

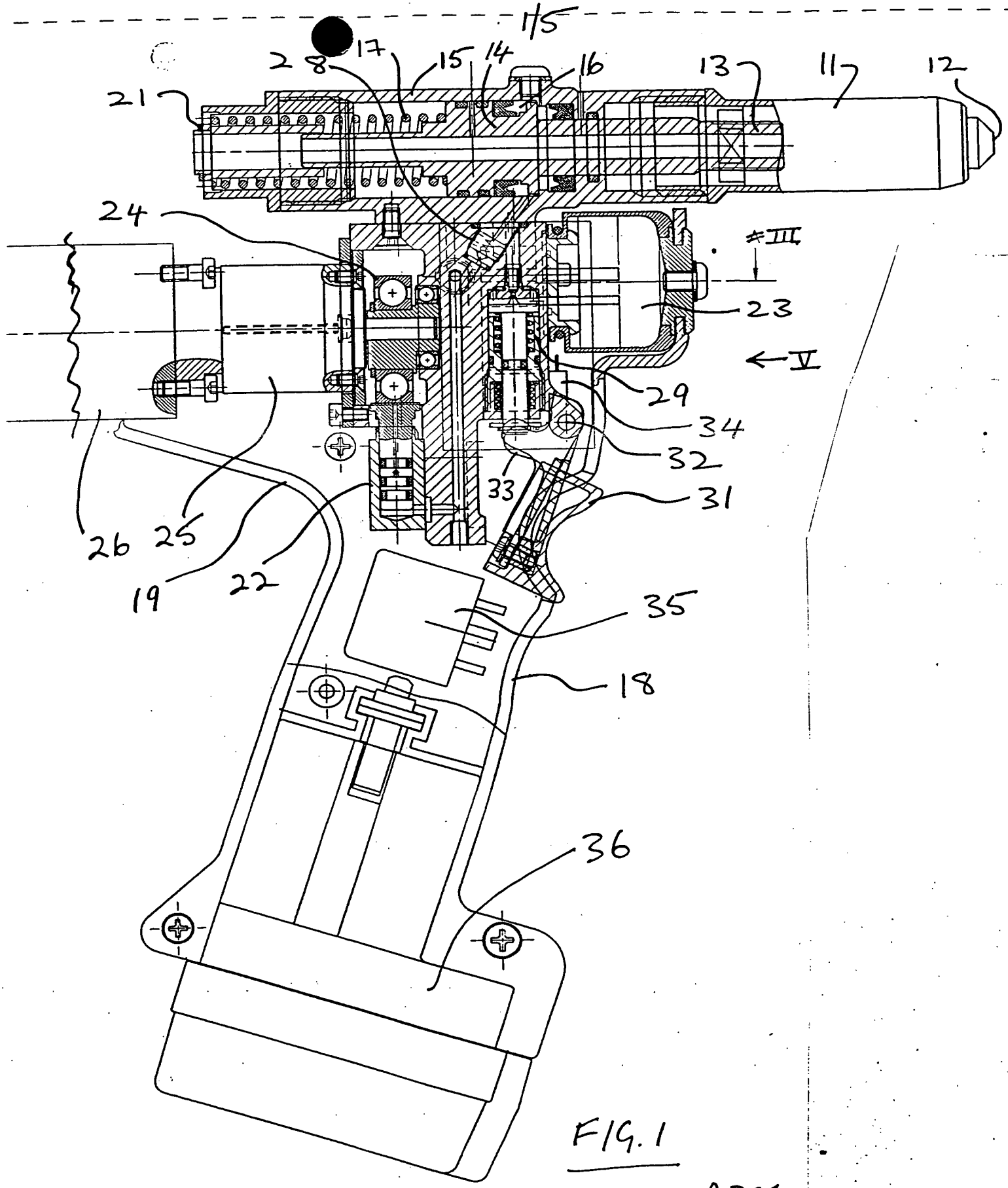
3. A riveting tool as claimed in claim 2, in which release of the tool-actuating device firstly switches off the electric motor to stop operation of the pump, and then opens the reservoir inlet valve.

4. A riveting tool as claimed in claim 2 or claim 3, in which the reservoir inlet valve when closed by operation of the tool-actuating device as aforesaid also acts as a pressure-relief valve to relieve over-pressure of hydraulic fluid.

5. A riveting tool as claimed in claim 4 in which the reservoir inlet valve is urged closed by a first spring with a first predetermined force and is urged open by a second spring with a second predetermined force, operation of the tool-actuating device removing the action of the second predetermined force, whereby the valve is thereafter held closed by the first predetermined force regardless of sustained operation of the tool-actuating device, thereby to

ABSTRACT

A hand-held riveting tool is driven by a battery-powered electric motor (26), and comprises a hydraulically-actuated riveting head (11), and a reciprocating hydraulic pump (22) driven by the electric motor. The tool includes a reservoir (23) for hydraulic fluid, the hydraulic supply line from the pump to the riveting head (11) being connected to the reservoir (23) by a reservoir inlet valve (29) which is normally open to allow hydraulic fluid to flow from the supply line into the reservoir (23). Operation of the tool-actuating trigger (31) firstly closes the reservoir inlet valve (29), and then switches on the electric motor (26) to operate the pump (22). Release of the tool-actuating trigger (31) firstly switches off the electric motor (26) to stop operation of the pump (22), and then opens the reservoir inlet valve (29). When the reservoir inlet valve (29) is closed by operation of the trigger (31), it acts as a pressure-relief valve to relieve over-pressure of hydraulic fluid.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11
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III
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V
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FIG. 1

P-386

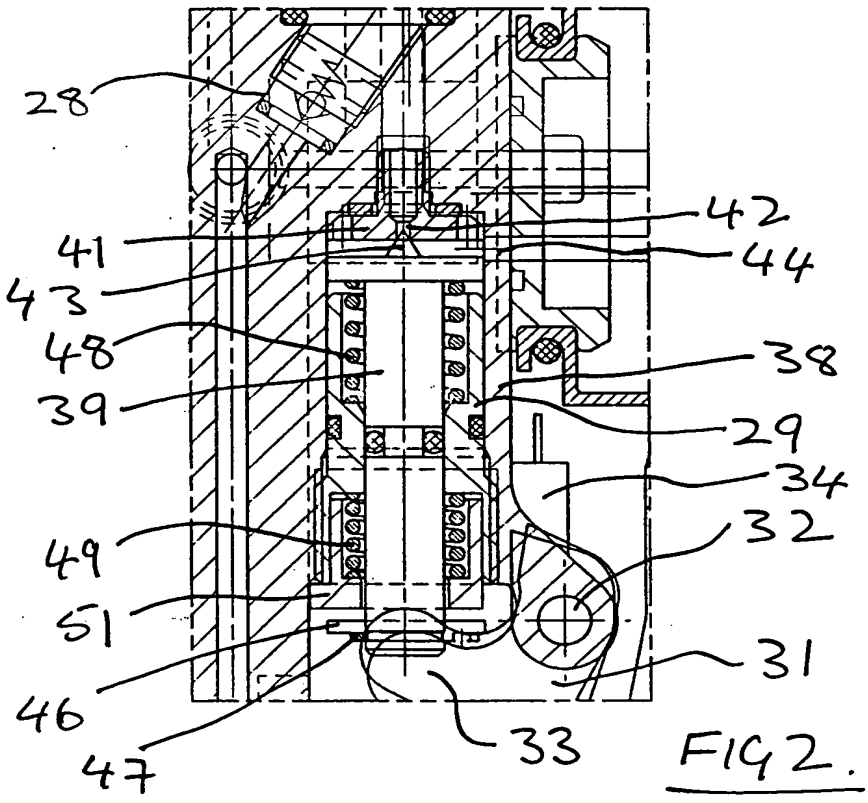
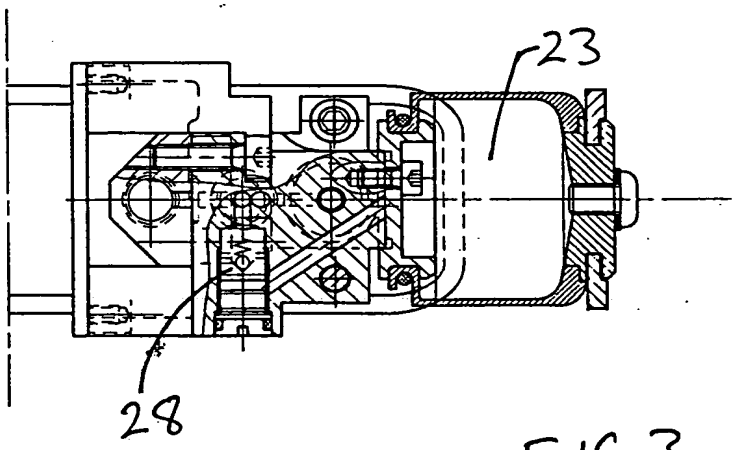
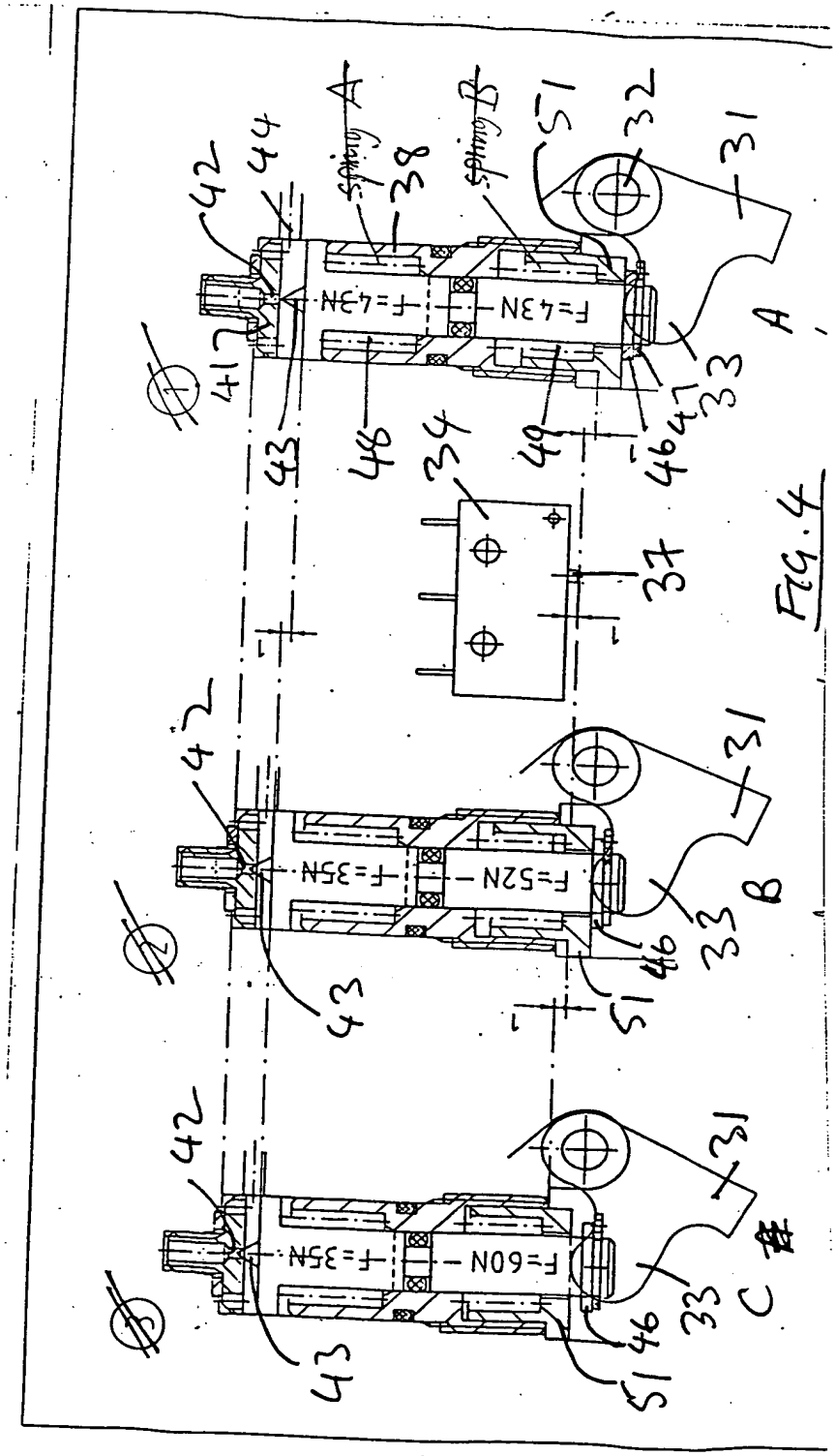


FIG 2.



VIEW ON A

FIG. 3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F=43N
F=52N
F=35N
F=60N
F=35N
A
B
C
31
32
33
34
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38
41
42
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Spring A
Spring B

FIG.4

FIG.4

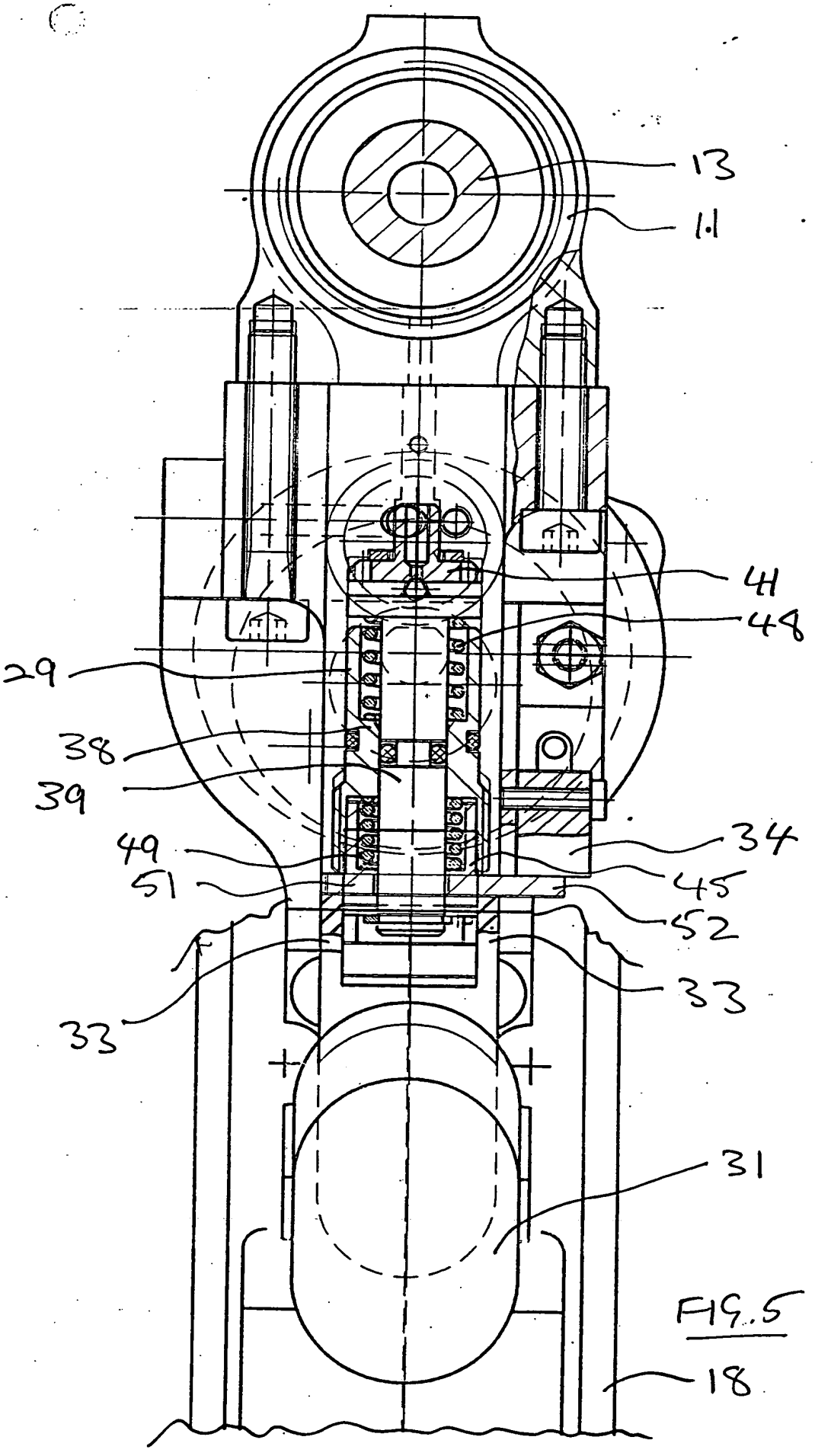

FIG. 5

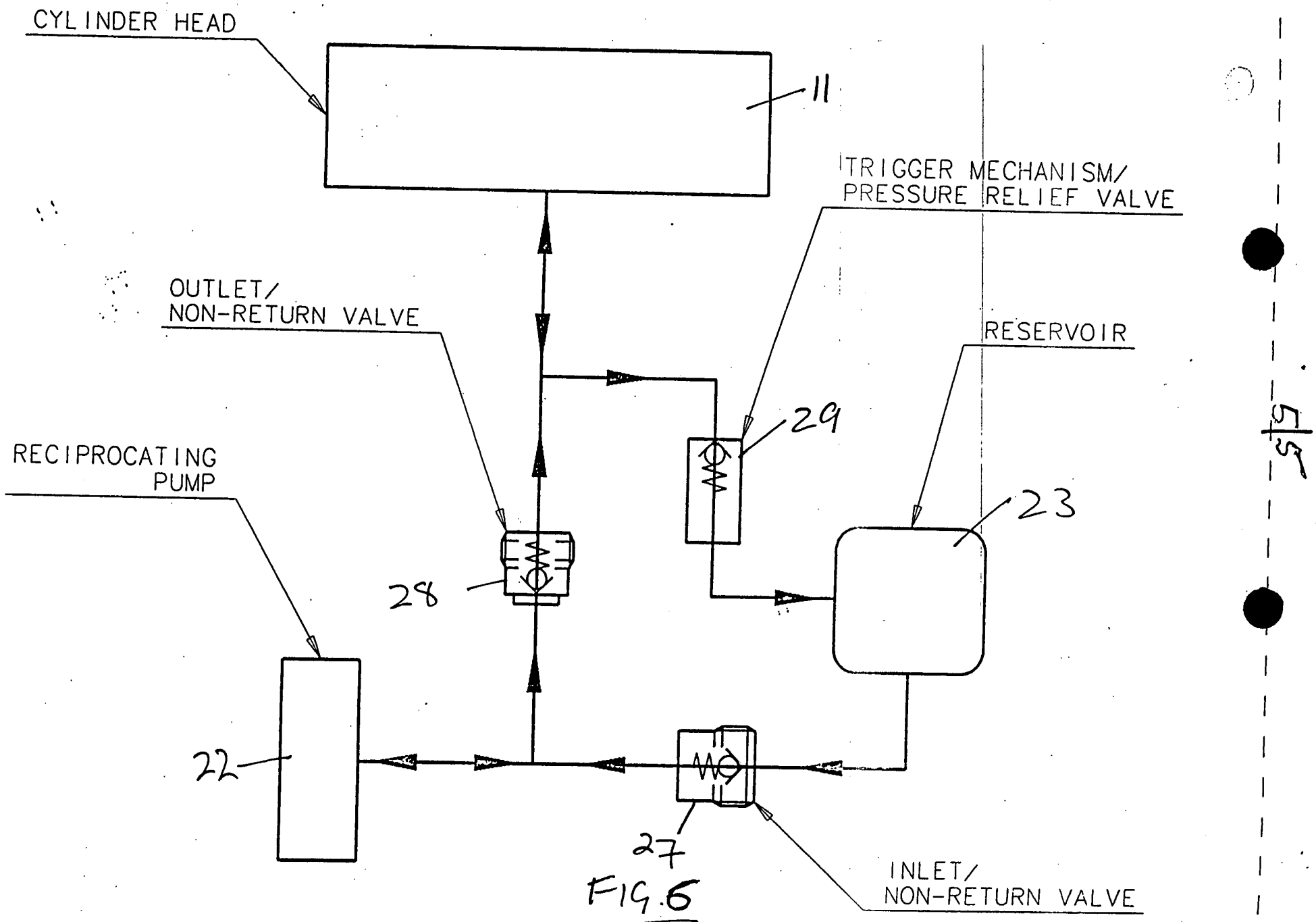
CYLINDER HEAD
11
TRIGGER MECHANISM/
PRESSURE RELIEF VALVE
OUTLET/
NON-RETURN VALVE
RESERVOIR
29
RECIPROCATING
PUMP
23
28
22
27
INLET/
NON-RETURN VALVE

FIG.6